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in the service, made a determined effort to defeat it, which was only so far successful as to defeat it in the senate once of the three times it was there considered after leaving the house of representatives, where it was passed by a small majority. By some it is believed that the whole proceeding originated in republican party warfare against the 'mugwumps' and free-traders at Yale college. This much is certain, that the ordinary friendliness which might exist between the college and the state was lacking in the case of many members of the general assembly. The governor, who was known to be personally strongly in favor of the observatory service, found himself in a delicate position, and doubtless, in the absence of any thing unconstitutional in the repeal, took the only course open to him which would be open to no misconstruction.

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PROFESSOR JAMES GEIKIE of Edinburgh contributes a very valuable article on the physical features of Scotland to a recent number of the new Scottish geographical magazine. It is illustrated by a beautiful little orographical map of Scotland by J. Bartholemew, in which the physical relief is finely brought out. Commenting on this, and on the excellent maps of the Ordnance survey on which it is based, Professor Geikie concludes with the following paragraph:—

"With such admirable cartographical work before them, how long will intelligent teachers continue to tolerate those antiquated monstrosities which so often do duty as wall-maps in their schoolrooms? Surely more advantage ought to be taken of the progress made within the last thirty or forty years in our knowledge of the physical features of our country. It is time that the youth in all our schools should be able to gather from their maps an accurate notion of the country in which they live; that they should see the form of its surface depicted with an approach to truth, and learn something more than that so many principal rivers flow in so many different directions. With a well-drawn and faithful orographical map before him, the schoolboy would not only have his labors lightened, but geography would become one of the most interesting of studies. He would see in his map a recognizable picture of a country, and not, as at present is too often the case, a kind of mysterious hieroglyphic designed by the enemy for his confusion."

We copy this with hearty emphasis and approval, for it points out precisely the difficulty under which our scholars labor. But while in Great Britain, and in continental Europe generally, the surveys from which good school-maps might be constructed are already well advanced or completed, in our country they are either neglected or only just begun; and it is even still almost always a difficult matter to persuade state legislators, from whom appropriations flow, that good maps are needed. It is no exaggeration to say that the educational value of such maps as are now in preparation in New Jersey and Massachusetts is alone more than their cost to the state; and we shall watch for the better teaching in the common schools, that must follow their completion, with as much interest as for the inception of similar work in other states.

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#### LETTERS TO THE EDITOR.

##### Centrifugal force and the supposed polar ice-cap.

IN your issue of March 27, you publish an article by Dr. Franz Boas, upon 'Mr. Melville's plan for reaching the north pole,' in which there are some statements that should not pass unchallenged. They occur in the discussion of the effect, upon the supposed 'ice-cap,' of centrifugal force due to the earth's rotation.

The formula for calculating the effect of centrifugal force is a well-known and simple one,  $C = \frac{wv^2}{32.16r}$ , in which  $v$  = velocity in feet per second,  $r$  = radius in feet,  $w$  = weight of the mass acted on, and  $C$  is the centrifugal force in pounds. Apply this to latitude  $85^\circ$ ,  $r$  = 345 miles, or 1,821,600 feet, and  $v$  =  $132\frac{1}{2}$  feet per second.

Then, if we take a cubic foot of ice,  $C = \frac{1}{10}$  of a pound, or about one hundred grains of pull, away from the pole, southward, upon each cubic foot of ice, — a force which is approximately one four-thousandth of the weight of the body acted upon, instead of being thirty thousand times that weight.

Whether the ice is one foot thick, or one hundred feet in a single block or in a broad or heaped mass, makes no difference in the result; for each unit of mass acts independently of each other unit. So far as centrifugal force goes, it could neither make nor mar the hypothetical 'ice-cap.'

E. W. WETMORE.

Essex, Conn., April 11.

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In the controversy between Mr. Melville and Dr. Boas respecting the supposed polar ice-cap, both parties appear to take an erroneous view of the action of 'centrifugal force.'

The notion of centrifugal force, like other examples of the so-called 'force of inertia,' is used simply to enable us to treat a body whose particles are not all moving uniformly in straight lines as in statical equilibrium. Thus, by imagining a force following a certain law of intensity acting outwardly from the earth's axis, in co-existence with the force of gravity, we may regard the earth as a stationary body, subject to these forces. It is the resultant of these forces which we commonly regard as the force of gravity; and, the earth having assumed the form of equilibrium, with a surface everywhere normal to this resultant force, there is no more occasion to consider the centrifugal force as acting independently. But, if we choose to do so, then we must regard the radial force of gravity as acting also; and the centrifugal force acting at any point is then balanced by the force which would, if the earth were not in rotation, reduce it to a spherical form. Thus the centrifugal force can create no tension in an ice-cap, and there is nothing in the nature of the forces acting to interfere with the existence of a continuous ice-cap round the pole, whether symmetrically situated or not. Of course, if a mass of ice were piled up at the pole above the spheroidal surface of equilibrium, lateral pressure would exist, but only in the same way that it would under like circumstances in any other part of the earth; and, wherever this pressure met insufficient resistance, the ice would 'flow' away in glaciers, just as it does from any elevated region of the earth's surface.

WM. WOOLSEY JOHNSON.

#### Digestion experiments.

An agricultural experiment-station has to contend against the prejudices of a public which demands speedy work and preposterous generalizations rather than accuracy. When a station, therefore, does do work of a scientific character, it is especially desirous of recognition on the part of science, as such recognition not only brings encouragement to the workers, but also has an influence upon the public to educate toward better expectations and wiser demands. What suggests this remark is an article in *Science*, April 10, entitled 'Errors in digestion experiments,' from which the reader would infer that Professor Armsby's experiments upon digestion were the only ones of that character which have been made in this country. As a matter of record, however, I presume the New-York agricultural experiment-station, in its Bulletin No. lxxxv., May 17, 1884, is entitled to the claim of having first published the results of a trial upon the digestibility of a ration in part composed, in the one case, of corn-fodder, and, in the other, of the same material ensilaged. In the forthcoming report of the station for 1884, the figures of these trials, as well as of others, will appear in considerable detail.

E. LEWIS STURTEVANT.

Geneva, N. Y., April 13.

#### Volcanic dust from south-western Nebraska.

There were received at the national museum a few weeks since, from a gentleman in Nebraska, samples of a fine white and very sharp dust, supposed by the sender to be of geyser origin. The deposits from which the samples were taken are stated to be semi-circular in outline, from four to ten feet in thickness, and of varying grades of fineness, situated on the banks of small streams that flow into the Republican River. The precise localities given are, Furnas county, two miles south of the Republican River, in sections 9 and 10, township 3, north range 21 west; and Harlan county, one mile south of the river, sec-

tions 10 and 11, township 2, north range 20 west; though the writer states that he has also found similar deposits in Kansas, Colorado, and Wyoming.

An examination of the dust with a microscope shows at once that it is not of Geyser origin, being composed almost wholly of minute fragments of pumiceous glass, with only very rarely a small particle of hornblende. Portions of a coarser deposit, associated with the dust, contain numerous rounded fragments of felspar, a part of which at least is triclinic, as shown by twin striations, and hornblende and magnetite particles. The deposits are therefore, without doubt, volcanic dust and sand, owing their present arrangement to the assorting agency of water and atmospheric currents; and their mineral composition would indicate that the corresponding lava was an andesite.

The matter is deemed of sufficient importance to mention here, from the fact, that, so far as I am aware, no deposits of dust of this nature have heretofore been reported east of the Rocky-Mountain region.

GEORGE P. MERRILL.

U. S. nat. museum, April 13.

#### Hastings's theory of the corona.

Your reviewer of the 'Report of the eclipse expedition to Caroline Island' has, by an unfortunate expression, so entirely misrepresented my theory regarding the solar corona, that a correction is necessary. Instead of supposing that the "coronal phenomena may be fully accounted for by applying the well-known principles of diffraction," as he asserts, I demonstrated that these principles completely fail to account for any part of them. What I did do was to prove that Fresnel's theory is not applicable to the case where both source of light and screen are at an indefinitely great distance from the observer; for then the implied constancy of phase of the wave-surfaces certainly does not exist. This limitation of the theory of diffraction does not seem to have been noted before; and it necessarily implies a distribution of light about the moon during a total eclipse which may be like that of the corona. Assuming that the corona is so formed, I show that all its characteristics (with the exception of the occasional filamentous structure, where the indication of the theory is doubtful) may be explained naturally and easily, even the polarization and absence of the Fraunhofer lines.

I may venture to describe briefly two observations of interest given in detail in the report, since they have not been noted in the review, and have been published only in the report. The first is Professor Holden's observation of the so-called 'shadow-bands' seen just before and just after totality, and which so strikingly suggest a diffraction phenomenon. No one before him, so far as I know, has determined with any useful precision their azimuth, nor had it before been recognized that they move in opposite directions at the two epochs. That their azimuths are those of planes tangent to the sun at the points of second and third contacts, is perhaps not of such immediate interest as the observed reversal of motion, since the latter feature excludes the more favored explanation which makes them shadows.

The other point is the proof that the 'b' group must be regarded as belonging to the same category as 1474 K, the hydrogen lines H and K; namely, that of bright corona lines. This renders it extremely probable that all the brilliant as well as high chromospheric lines are also coronal lines. The fact must be regarded as a strong indication in favor of the theory advocated.

C. S. HASTINGS.

New Haven, April 13.